VOL. 29 NO. 5 SEPTEMBER-OCTOBER, 1951

THE EXPLOSIVES ENGINEER

REG. U.S. PAT. OFF.

Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

IN THE ARTICLE "Electric Blasting Circuits—Hazards from Radio Frequency Energy," by Dr. R. W. Lawrence of Hercules Powder Company, the author states: "There have been reports from time to time that electric blasting caps can be exploded by radio waves, and it has been confirmed by trials that this is so under certain special conditions. . . . This whole subject is quite complicated and conditions are constantly changing."

For further details please turn to page 135.

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THE AWARD of the Sentinels of Safety trophy to the employes of Reliance No. 7 mine of The Union Pacific Coal Company, for the third consecutive time, made mine safety history. Officials of the company were host to the winning miners and guests at a dinner-ceremony in Rock Springs, Wyoming, September 21. A description of the proceedings may be found on page 138.

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BLASTING DITCHES with dynamite to reclaim wet, mucky bottom land in Barbour County, West Virginia, with a minimum expenditure of time and money, is described in the article on page 148, by E. A. Pais.

••

COAL FOR FUEL at Duquesne Light Company's power stations, near Pittsburgh, is delivered by river barges from the company's Warwick mines in Greensboro, Pennsylvania, where daily production averages 5,000 tons of coal. A summary of the activities at the mines is described by J. P. Hastings, beginning on page 144.

EDITORIAL STAFF: JOSEPH I. HORTY, *Managing Editor;* ELIZABETH M. JOYCE, *Assistant Editor;* GERTRUDE A. DONNELLY, *Assistant Editor;* EDWARD L. GRANT, *Art Editor;* FRANK J. CANOVA, *Production Manager;* CHARLES E. RABENOLD, *Advertising Manager;* THEODORE MARVIN, *Director;* MONTGOMERY R. BUDD, *Associate Director.*

SUBSCRIPTION RATES: *United States and Canada*—One Year, $1.50; Single Copies, $.30. *Limited Subscriptions Only to Other Countries*—One Year, $2.50; Single Copies, $.50.

THE EXPLOSIVES ENGINEER, 913 DELAWARE TRUST BUILDING, WILMINGTON, DELAWARE. PRINTED IN UNITED STATES OF AMERICA.
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IMPRESSIVE CEREMONIES were held at the Tobin mine of Republic Steel Corporation, Crystal Falls, Michigan, August 30, 1951, to pay tribute to the local miners for having had the best record in the National Safety Competition, in the metal mines group. Approximately 200 employes and officials of the company and their guests participated. The highlight of the program was the award of the Sentinels of Safety trophy.

An article describing the ceremonies begins on page 150.

••

ERRATUM IN JULY-AUGUST, 1951, ISSUE: In presenting the diagram of a typical tunnel round on page 105 of the article "B&O Railroad Builds a New Tunnel Near Clarksburg, West Virginia," the figure 2 was shown above one of the "Baby V" cut holes in the lower center of the round. This indicated that a 2nd delay period electric blasting cap was used as the detonator in the hole. This figure should have been shown as 0 (Zero) indicating that a Zero No Vent* Delay Electric Blasting Cap was used as the detonator in the hole.

We regret that the above inaccuracy was not detected before the article was printed.

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FRANK FREDERICK KOLBE

Frank Frederick Kolbe

PRESIDENT

THE UNITED ELECTRIC COAL COMPANIES

A Biography

TEACHING economics, banking, private and government finance, president of a film company—perhaps this succession of business activities does not fulfill the popular conception of the steps leading to the management of important coal properties. However, that is the route by which Frank Frederick Kolbe arrived as president of The United Electric Coal Companies. No one with an eye on results is likely to suggest that he followed the wrong road.

Frank, as he is known to his friends and associates, was born in Ann Arbor, Michigan, December 4, 1892, the son of Charles Frederick and Henrietta Amalia Kolbe. After completing the courses in the local grade school and high school, he continued his education at Alma College. At the end of the freshman year, Frank transferred to the University of Michigan, from where he was graduated in 1914 with an A.B. degree.

Following his graduation, he accepted a job at the university, as an instructor in economics, continuing in that capacity for the next three years. While on this teaching assignment, he took postgraduate work, and in 1917, was awarded his Masters degree.

Frank left his post at the university in 1917, to work for National City Company in New York. The following year he moved to Washington to become associated with the War Credits Board. In 1919, he joined General Motors Corporation and was an assistant treasurer in that organization from 1922 through 1928.

In August, 1929, when the bull market in stocks and related securities was almost at its peak, Frank and six associates formed a private investment trust called Aldebran Corporation, with Mr. Kolbe as president. In 1936, the corporation was liquidated for tax purposes. It paid out twice as much for each member's share as was invested originally.

Frank formed a partnership with Robert R. Young in 1932, under the name of Young, Kolbe & Company. The new company became a member of the New York Stock Exchange. Three years later, he became president of Pathé Film Corporation and continued as its chief executive until 1937. In that same year he, together with Allen P. Kirby and Robert R. Young, purchased the controlling interest in Alleghany Corporation. A year later, he withdrew his holdings.

Frank Kolbe's association with the coal industry began in 1934, when, with two associates, he purchased the then-largest interest in the stock of The United Electric Coal Companies. The following year, he was elected a director of the company; in 1939, he was made its president. It is of interest to note that in 1935 United Electric's coal production was 1,329,315 tons and, at the end of the year, the balance sheet showed a loss of $47,505. For the fiscal year 1951, production was increased to 4,274,390 tons, with a profit to the company of $2,100,000.

Frank developed a new mechanical unit for use in strip-mining coal, called the Kolbe Wheel Excavator. The new machine makes possible the economical stripping of coal at greater depths than was possible before its introduction.

Frank Frederick Kolbe married Marjorie Heartt in 1922, in Ann Arbor. They have two children, Frederick and Elizabeth. The family home is at 40 Indian Hill Road, Winnetka, Illinois.

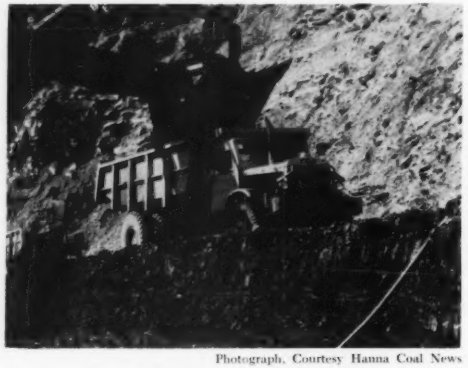
His club memberships include Longmeadow Hounds, Chicago, Indian Hill, and Glen View.

When time and opportunity permit, Frank Kolbe finds relaxation in his principal hobbies—fox hunting with the Longmeadow hounds or matching his skill with a shotgun in friendly rivalry at skeet and trap shooting clubs in Illinois.

Editorial

The Improved Position of Coal

The frequently expressed belief that coal is destined to become an important chemical raw material seems likely to be realized in the not-too-distant future. Figures released by the Bituminous Coal Institute show that our reserves are ample for any conceivable demands that may be put upon them.



Photograph, Courtesy Hanna Coal News

The Institute points up the fact that the great coal-producing areas in eastern and central states, from which the nation today is drawing 90 per cent of its coal requirements, contain only about one-third of the recoverable coal reserves in the United States. "These areas have been the primary sources of coal in the United States because they have been close to the centers of great industrial and population growth in the past. The coal fields of Utah are becoming important suppliers of fuel for the growing industry of the West. The great deposits of Wyoming, North Dakota, and Colorado, which hold about 40 per cent of America's original coal reserves, might provide the raw materials for the making of synthetic oil and gasoline in the future. So far they have barely been touched."

The Dark, Gloomy Days

The bituminous-coal industry has come a long way since the dark days in the 1920's and 1930's when near-chaotic conditions often prevailed for protracted periods. The outlook, at that time, seemed to indicate a permanent state of depression. There were gloomy predictions, some of which have come true without bringing disaster. There was alarm over the inroads made by oil as a fuel for household heating and locomotives. Those inroads have been substantial, but they have been offset by gains in markets such as coke ovens, power-generating stations, and export.

This and much more encouraging information is contained in a recent analysis of the bituminous-coal industry by a New York investment firm for distribution to its clients. The analysis brings out the fact that increased mechanization in coal mining, with the attendant increase in production per man-hour, is one of the important factors that have helped to bring about the improved situation both in underground and open-pit mines. Advancements in the methods of coal preparation have been important, resulting in reduced costs and increased uniformity in the quality of the product.

An Expanded Demand For Coal

The analysis states that "Coal is essential in the production of pig iron and steel, and the current 20-million-ton expansion of steel capacity will involve an expanded demand for coal. Of even greater potential importance, the electric utility industry is raising its generating capacity by 40 per cent over the 68 billion kilowatt figure of January, 1951. Some of the new generating stations will be fueled by gas, some by oil, but the larger number will be fueled primarily by bituminous coal. . . . The long-term national upswing in the consumption of coal by the utility companies appears likely to continue.

"The greatest relative increase in coal demand is now coming from Europe. . . . Marshall Plan specialists and industry executives look for shipments to the continent to approach 40 to 50 million tons annually, as shipping becomes available. . . . If European industry continues to expand, coal supplies within Europe itself may well be inadequate for many years."

The improved position of coal in our economy seems destined to continue to move up in the months ahead.

Metal and Nonmetallic Mining Convention in Los Angeles

As we go to press, reports from the American Mining Congress indicate that approximately 2,000 men from the mining and allied industries will attend the 1951 Metal and Nonmetallic Mineral Mining Convention in Los Angeles, October 22 through 24.

The convention program includes group meetings for discussions of the latest operating advances in metal and nonmetallic mining, both underground and open pit.

Exploration and expansion developments to increase the production of critical raw materials will be reviewed at round-table sessions.

The meeting in Los Angeles promises to be of great importance to mining men in providing opportunities for thorough examination of the many problems involved in increasing the output of metals and nonmetallic minerals for war and civilian uses.

Electric Blasting Circuits—

HAZARDS FROM RADIO FREQUENCY ENERGY

BY DR. R. W. LAWRENCE*

THERE have been reports from time to time that electric blasting caps can be exploded by radio waves, and it has been confirmed by trials that this is so under certain special conditions. It is not generally easy to fire electric blasting caps in this way, hence an understanding of the conditions under which the possibility of firing them exists should make it possible to operate with relative safety. This whole subject is quite complicated and conditions are constantly changing. Therefore, proper consideration should continue to be given to it.

SOURCES OF RADIO WAVES

According to the Federal Communications Commission more than 150,000 radio stations have been authorized, including more than 4,000 in the broadcasting service; hence it is desirable to know the kinds of radio equipment in use, and the hazards likely to be encountered from each. The danger, of course, is from transmitting sets and not from receivers. The general types of radio sending units include those shown in Table I.

TABLE I

Commercial Broadcasting	AM up to 50,000 watts. FM up to 550,000 watts. Television up to 50,000 watts.
Amateur	Up to 1,000 watts.
Two-Way Communication Systems Including Radio Telephones	Up to 60 watts for the portable transmitters and 5,000 watts for the fixed or central transmitters—used by taxis, police and fire departments, individuals, industrial organizations, and others.
Transmitters on Boats	Up to 8,000 watts.
Radar and Microwave Relay	Up to 1,000 watts or more.

A summary of significant data on various broadcasting and other radio systems is shown in Table III.

HOW IT CAN HAPPEN

The wires of an electric blasting cap can act as an antenna and pick up radio energy, and if the configuration of wires is just right, and the radio transmitter is close enough, the bridge wire in the cap can be heated sufficiently by the radio frequency current produced in the wires so that the cap can be exploded.

The radio frequency current induced in an antenna is a high-frequency alternating current. A peculiar feature of radio frequency current is the fact that the actual current varies at different points along an antenna, and is at a maximum at certain points and zero at others, varying continuously in between. Thus if the cap wires acting as an antenna are of such a length or configuration that induced current is at a maximum at the point where the electric blasting cap is located, then the greatest possibility of firing the electric blasting cap exists. (The current needs to be of the order of 0.25 ampere or more.) On the other hand, if the cap is at a point where the current has a very low or zero value, then the cap will not fire even in close proximity to the sending set. The greatest danger arises when the two wires of the

*Hercules Powder Company, Inc., Wilmington, Delaware.

cap have a total length equal to one-half wave length, with the cap in the middle. A serious danger also exists if one wire is one-quarter wave length and the other is grounded close to the cap.

ELECTRIC BLASTING CAPS HAVE BEEN FIRED BY RADIO

It has been reported to us that an electric blasting cap was actually shot by a radio transmitter on a boat which was engaged in seismic prospecting. In this case the antenna was strung between two masts. The 50-watt transmitter had a frequency of 1,602 kilocycles, which corresponds to a wave length of about 600 ft. In this particular case the cap wires had been strung out on the deck preparatory to putting a charge overboard when the radio transmitter was turned on and the charge was shot on deck.

In tests made by others, electric blasting caps have been fired 300 ft. from a 5,000-watt commercial broadcasting station, with a frequency of 610 kilocycles, corresponding to a wave length of about 1,600 ft. Under such circumstances it is necessary for the cap to be located between quite long lengths of wire so that they will act as an efficient antenna. Electric blasting caps have also been fired on the ground 20 ft. from 200-400-watt transmitters with frequencies between 2,000 and 18,000 kilocycles.

It has been reported that an electric blasting cap placed in the rear compartment of a police car which had a transmitter was exploded while the transmitter was operating.

In experiments with a 100-watt amateur radio it was possible to shoot electric blasting caps 20 to 30 ft. below the horizontal antenna. Other trials with a 10-watt police radio indicated that electric blasting caps could be detonated at a distance of 1 to 2 ft. when the radio was equipped with a special half-wave sending antenna but not with the regular one-quarter wave antenna. Other tests with 30-watt transmitters on automobiles indicated that electric blasting caps would have to be within 2 or 3 ft. of the transmitters to be exploded.

We have also received warnings from others that hazards exist within 25 ft. of such transmitters.

TESTS ON RADIO FIRING OF ELECTRIC BLASTING CAPS

Amateur Transmitter—100-watts—3,500 kilocycles with horizontal antenna, 134 ft. long, 20 to 30 ft. high

The largest currents (0.5 ampere) were induced at a point in the center of a 134-ft. length of cap wire, which is equal to half a wave length, and which was raised from the ground, just under the antenna. When electric blasting caps were placed at the center point with one-quarter wave lengths of wire on each side, they could be shot quite readily. The electric blasting caps could also be shot with various other configurations when lengths of wire were equal to one-quarter wave length. Electric blasting caps could not be shot if they were at the center of a wire one-quarter wave length long, or equal to odd (3, 5, etc.) multiples of a quarter wave length.

Running the cap wires at right angles to the radiating antenna greatly reduced the danger. In this test the moving of the cap wires 60 ft. from the antenna almost eliminated the induced currents.

When the cap wires were in the original bundle furnished by the manufacturer, or in loops, we were unable to detect any current.

Police Radio—10-watt, FM, 156 megacycles, 6 ft. Wave Length

Firing of electric blasting caps required a special half-wave antenna with a six-watt output. When the wires on the cap were cut to one-quarter wave length (18 in.) and the wires were separated to form a straight wire 3 ft. long with the cap in the middle, the cap could be shot within 1 to 2 ft. of the antenna. However, a change of 1½ in. in the wire lengths either way practically eliminated the possibility of firing the electric blasting cap. Loops in the wire were much less effective in firing the electric blasting cap than the half-wave antenna. Placing the cap and wires on the ground also made it more difficult to fire the cap. Attempts to fire the electric blasting cap with the quarter wave antenna, with which the car was equipped, also failed. In the last three cases we were unable to fire Hercules® Electric Blasting Caps but a small amount of current was induced indicating that a hazard exists.

Radiotelephones (Bell System)

30 w. 154.5 megacyc.	Wave Lgth.= 6 ft.
30 w. 43.66 megacyc.	Wave Lgth.=20 ft.

Cars equipped with these radios had vertical antennas. It was necessary to have the cap wires (cut to one-quarter wave length) within 1 or 2 ft. to induce dangerous currents. The currents were greater when the wires were parallel to the antenna than when they were at right angles.

Radar

MICROWAVE	
300 watts*	10 cm. (4 in.) wave length
100 watts*	10 cm. (4 in.) wave length
40 watts*	3 cm. (1.2 in.) wave length

*Figures are for average power which is considered more significant than the very high peak power in the individual pulses which may run as high as one million watts.

It was possible to hold electric blasting caps in the radar beam and bring them right up within inches of the transmitter without shooting the electric blasting caps. Efforts were made to tune the cap wires to the radar waves by cutting them off to 2 in., bending them at right angles to the cap, and then removing small increments of the wire until they were completely cut off, but in no case did the electric blasting caps shoot. However, small photoflash bulbs requiring 0.25 ampere to fire them could easily be ignited in the radar beam 75 ft. from the transmitter. Other investigators have succeeded in shooting electric blasting caps within a foot of a 10-cm. wave length radar.

A microwave radar beam can be easily detected with a neon test lamp or even with ordinary fluorescent lamps. It is thought that there is little hazard from a microwave radar, since the beams are generally directed upward and they are easily stopped by a solid wall or other obstruction, and there is little possibility of tuning usual lengths of wire to the radar frequency. However, with longer wave length radar, such as Shoran, (see Table III), the danger is prob-

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ably considerably greater. Nevertheless, it is advisable, in any case, to keep electric blasting caps outside of the radar beams.

DETECTION OF HAZARDS

The location of commercial broadcasting stations in any area can be ascertained with the help of the telephone directory or the local newspapers. When one is in the vicinity of a radio station whose broadcasting frequency is known, it is easy to calculate the wave length—that is roughly 1,000,000 divided by the frequency in kilocycles or 1,000 divided by the frequency in megacycles. A more useful figure is the half-wave length. Hence, by spreading out the wires over a half-wave length, and placing a suitable test lamp in the middle, it is possible to determine whether dangerous currents would be developed if an electric blasting cap were in the same position. The following General Electric Pilot lamps may be found useful for this purpose: No. 47, 0.15 ampere; No. 48, 0.06 ampere; No. 292, 0.17 ampere.

When these are placed at the center of a length of wire equal to a half-wave length, they will glow if dangerous amounts of radio frequency energy are being picked up. The No. 48 lamp is the most sensitive, and if it glows would certainly indicate that one is in a dangerous location. Radio field strengths can also be determined with the aid of meters, but these are relatively expensive.

Presence of very high frequency energy, such as that from microwave radar is easily detected with a 2-watt, 115-volt, neon glow lamp which lights up brightly when placed in a radar beam of e.g. 10-cm. wave length. General Electric neon lamps, NE-34 and NE-36 are satisfactory.

GENERAL

The intensity of radio frequency energy falls off as the square of the distance from a broadcasting station (for a spherical wave). By way of example the energy intensity from a 100-watt station is the same as a 10,000-watt station at approximately 10 times the distance. However, broadcasting stations often use directional antenna so that radio wave intensities are far from symmetrical about the station. A radio with a nominal 5 KW rating might broadcast at 7.5 KW in one direction and very much less in others in order to avoid interference with other stations on the same wave length, and its pattern might be different at night than during the day.

FM and TV stations are so constructed that the intensity of radio waves corresponds to a much greater value than one would expect from the power input. They are rated, however, according to the intensity of radiation. FM and TV antennas are usually located on high towers, so that intensity of radiation at ground levels may be relatively low.

For sending stations which transmit the radio energy in the form of a beam, such as radar, the intensity will fall off very much less rapidly than even proportionately with the distance.

PRECAUTIONS

The three most effective precautions are:

(1) Keep electric blasting caps and conduct blasting operations at no less distance from a radio transmitter than indicated in Table II.

(2) When the radio sending station is under control of the blasting operator, keep radio transmitters turned off when in proximity to blasting operations.

(3) Where dangerous radio frequency energy exists or when there is any doubt as to the location or power output of the transmitter, it is recommended that electric blasting be eliminated and blasts be detonated with a non-electrical method such as Blasting Cap and Fuse or Primacord with Blasting Cap and Fuse.

It is also desirable to keep the wires on the ground. Other precautions such as keeping the wires oriented to minimize pickup of radio waves, setting up dummy circuits and placing test lamps at positions where caps are to be connected, etc., are valuable but require a knowledge of radio theory and practice not usually available to most blasting operators.

Shunts on electric blasting caps and otherwise in the circuit are purposely not discussed herein because we feel that such discussion would further complicate the subject and not be useful. Furthermore, if shunts offered any protection under certain circumstances, it would be lost when the shunts were removed as is necessary before blasting. Therefore, we can only suggest that the hazard from radio frequency energy be considered the same whether shunts are present or not.

We do not believe that present knowledge or experience is sufficient to formulate an accurate table of distances which should separate radio broadcasting transmitters from blasting operations using electric blasting caps. Such a table must be made up from tests and judgment as to a reasonable factor of safety and it can be either too restrictive for practical use or not sufficient for reasonable safety. Based on our tests and information from others and applying what we think is a reasonable factor of safety, we have arrived at the following table indicating the desirable minimum distance of separation between radio broadcasting transmitters and such blasting operations. All we can really say is that we and, so far as we know, others have not succeeded in shooting electric blasting caps at certain distances considerably less than the ones shown.

TABLE II

Power	Minimum Distance From* Blasting Operations Using Electric Blasting Caps
BETWEEN	
0 and 30 watts	100 ft.
30 and 100 watts	200 ft.
100 and 250 watts	500 ft.
250 and 1,000 watts	1,000 ft.
1,000 and 5,000 watts	2,000 ft.
5,000 and 50,000 watts	5,000 ft.
Above 50,000 watts	10,000 ft.

*This table does not apply to radar and international broadcasting, the energy intensity of which might be much greater than that from ordinary radio broadcasting transmitters because of their highly directional antenna.

(Continued on page 154)

IN OLD TIMERS' BUILDING: Approximately 450 employes and guests participated in a gala dinner-ceremony in Old Timers' Building, Rock Springs, Wyoming, September 21, to pay tribute to the victorious Reliance No. 7 miners. Officials of The Union Pacific Coal Company were the hosts.

Union Pacific Coal Company's Miners Make Safety History

Employes of Reliance No. 7 bituminous-coal mine in Wyoming make three-year record of 1,219,728 man-hours of work underground without a lost-time accident

In Rock Springs, Wyoming, on the night of September 21, the employes of Reliance No. 7 mine of The Union Pacific Coal Company made mine safety history when they were awarded, for the third consecutive time, the Sentinels of Safety trophy in the bituminous-coal division of the National Safety Competition. Their winning record in the 1950 competition was 449,090 man-hours without a lost-time accident.

Never before in the 26 years of this nationwide drive to end accidents and deaths in mines and quarries has a bituminous-coal property been operated with such safety precision. In the making of this three-year record, the men of Reliance No. 7 amassed a total of 1,219,728 man-hours without a lost-time injury. This remarkable record has been maintained through 1951 to date.

The Union Pacific Coal Company's mines have won the Sentinels of Safety trophy 12 times in 18 years of enrollment in the National Safety Competition. This remarkable record of safety in bituminous-coal underground mining is reflected in the listing below of the names of the winning mines and the years in which they won the trophy.

1933—"B" Mine, Superior, Wyoming
1934—"C" Mine, Superior, Wyoming
1937—"D" Mine, Superior, Wyoming
1938—"B" Mine, Superior, Wyoming
1939—Winton No. 1 Mine, Winton, Wyoming
1940—Rock Springs No. 4 Mine, Rock Springs, Wyoming
1943—"D" Mine, Superior Wyoming
1944—"D" Mine, Superior, Wyoming
1947—Winton No. 1 and 7½ Mine, Winton, Wyoming
1948—Reliance No. 7 Mine, Reliance, Wyoming
1949—Reliance No. 7 Mine, Reliance, Wyoming
1950—Reliance No. 7 Mine, Reliance, Wyoming

What kind of magic makes possible the brand of safety which rules the operations of The Union Pacific Coal Company at its numerous mines in Wyoming? "There's no magic to it," vouched Tom A. Burke, director of programs, Community Safety Councils for the National Safety Council. As the main speaker at the dinner-presentation ceremony, he spoke of the resurgence in safety determination which springs into being in any field of accident prevention when a city, an industry, a school, factory, mine, or family emphatically says: "No more of this evil! Accidents and deaths within our borders must stop!" "Thus," Mr. Burke said, "with intelligence and patience, the goal can be reached, and it is being reached all over America, particularly in mines and quarries, even at a time when accidents and deaths on highways and in other areas of life are

"CONGRATULATIONS": Theodore Marvin, director of The Explosives Engineer, left, makes the award of the bronze Sentinels of Safety trophy to H. C. Livingston, vice president of The Union Pacific Coal Company's operations.

TERRY MARTIN: On behalf of his fellow-miners, Reliance No. 7's fire boss accepts the bronze trophy from Mr. Livingston.

I. N. BAYLESS: The coal company's president extends congratulations to the miners, their wives, and sweethearts.

JOHN H. EAST, JR.: The Bureau of Mines representative awards individual certificates to the winning bituminous-coal miners.

LEFT TO RIGHT: V. O. Murray, general manager of the coal company, and Lawrence Welsh, superintendent of Reliance No. 7.

reaching new highs."

That Reliance No. 7 has refuted the age-old belief that coal mining cannot be a safe industry is an achievement brilliant beyond anything ever to be hoped for. Calling on the miners and their families to prove that safety education can also pay off in their homes, in their schools, and on the highways, Mr. Burke pleaded for the same kind of achievements by them and by the other dinner guests and radio listeners.

Parade Starts Festivities

With H. C. Livingston, vice president in charge of operations of The Union Pacific Coal Company, as toastmaster, the dinner-ceremony began with an invocation by the Reverend Albin Gnidovec. The dinner was served by the ladies of the local Latter Day Saints Church to the miners and guests who had marched from the Park Hotel through Rock Springs to The Union Pacific Old Timers' Building. Led by the coal company's famed Kiltie Band, with the three Sentinels of Safety banners—1948, 1949, and 1950—flying in the breeze, and the bronze trophy mounted on a float, the cavalcade gave notice to the community that "big doings" were under way.

Thus, for the twelfth time since its first enrollment in the competition, The Union Pacific Coal Company was host to its honored miners, their wives, sweethearts, and other guests. Aiding, by way of entertainment, were Robert Bowden and his orchestra, and a barbershop quartet, the "Alkali Flats."

"We Salute You"

First to salute the three-time winners—Reliance No. 7 miners—was the Governor of Wyoming, Frank A. Barrett, who said that this below-the-ground record is a challenge to the State of Wyoming to do something about its above-the-ground accident situation, especially on the highways. A. J. Seitz, executive vice president of the Union Pacific Railroad, said that carelessness is the real robber in public and private business, and extended the railroad's compliments to the miners. Assistant Secretary Robert

TOM A. BURKE: The National Safety Council's representative declared, "No magic was involved in making these records."

A. J. SEITZ: After extending compliments to the winners, Union Pacific Railroad's vice president said, "Carelessness is the real robber in public and private business."

F. A. BARRETT: "Everyone in our state is especially proud of you record-breaking coal miners," said the Governor of Wyoming.

R. R. ROSE, JR.: The assistant secretary of the Department of the Interior congratulated employes of Reliance No. 7 mine.

H. E. SHUMWAY: "The Wyoming coal mines have set an example for us," said the Union Pacific Railroad's general manager.

R. Rose, newly appointed to the Department of the Interior, brought Secretary Chapman's greetings. Now in charge of the Department of the Bureau of Mines and the U.S.G.A., Mr. Rose was particularly proud of this new safety record.

J. H. East, Jr., regional director of the U. S. Bureau of Mines at Denver, echoed the remarks of the other speakers to the effect that such a record had seemed impossible of achievement. He extended Dr. James Boyd's greetings and spoke of the pleasure the director experienced at the Sentinels of Safety trophy presentation in Rock Springs two years ago.

H. E. Shumway, general manager of the Union Pacific Railroad, also extended congratulations. In his talk, he told the miners that the example they had set in safety on the job was an encouraging one for their friends in the transportation industry.

Called upon to speak, I. N. Bayless, president of The Union Pacific Coal Company, added his congratulations to the others, and then referred to the presence of the wives and sweethearts of the miners who were the guests of honor at the banquet. He knew that they appreciated, more than anyone else, the real values of these fine records in eliminating accidents.

THE KILTIE BAND: A parade preceded the ceremonies in Old Timers' Building, led by the company's famous Kiltie Band.

Presentation of Trophies

In his presentation of the Sentinels of Safety trophy to Mr. Livingston,

(Continued on page 156)

QUARRY FACE: The limestone deposit in the quarry is an irregular formation of calcium carbonate overlapped with dolomite from an adjoining formation. The average working face is approximately 40 ft. high.

WELL-DRILL BLASTING IN BLOCKY CALIFORNIA LIMESTONE

A summary of operating proceedures at West End Chemical Company's quarry in the Slate Range Mountains

PAT and GEORGE STURTEVANT*

EXPLOSIVES play an important part in the production of heavy chemicals at The West End Chemical Company's plant in Westend, California, where heavy chemicals are lured from Searles Lake brine by use of a carbonation process. The process involves the utilization of carbon dioxide gas procured from limestone obtained from the company's quarry in Slate Range, 18 miles north of the plant site.

Searles Lake is a playa located in the northeastern part of the Mojave Desert, about 40 miles from Death Valley. Beneath the dry crust of the lake an endless supply of heavy chemicals lies entrained in the rich brine. The West End Chemical Company pumps this brine into its lakeside plant and subjects it to processing by the carbonation method, which yields an annual production of 185,000 tons of critical borax and soda ash.

The carbon dioxide gas, which plays an important part in the West End Company's operation, is produced in limestone kilns. Each day, 200 tons of the CO_2 gas is produced from 250 tons of crushed limestone burned with coke. In addition, the kilns produce approximately 18,200 tons of lime hydrate as an important by-product.

Charles E. "Chuck" Ousley, a quarryman for more than 30 years, is superintendent of the quarry that produces the limestone. Superintendent Ousley and his 11-man crew blast loose approximately 100,000 tons of rock annually from an open pit gouged deep into a spur of the Slate Range Mountains. Of this tonnage, 80,000 tons is limestone in a form suitable for use in the kilns. The remaining

*Trona, California.

LOADING EXPLOSIVES: One of the crew loads Hercomite bag powder into a 6-in. well-drill hole preparatory to firing a blast in the quarry face. C. O. Mayer, Hercules Powder Company representative, is at the left in the picture.

STEMMING: The explosives charge in each blast hole in a primary blast is covered to the rim of the hole with 20 to 22 ft. of stemming. Screenings from the crushing plant waste pile are used as the stemming material for each charge. (Superintendent C. E. Ousley, at right.)

20,000 tons, made up largely of fines which sift through the 2-in. screen and silica plucked from the belt by hand, classified as waste. However, these smaller sizes find a commercial outlet in sales for use as railroad ballast and road surfacing.

The limestone deposit in the quarry is an irregular formation of calcium carbonate. It is overlapped with dolomite, rich in calcium magnesium carbonate, from an adjoining formation. Unfortunately, the overlapping dolomite is not useful in the West End Company's process.

Blasting Procedure

Benefiting from the impetus given the operation by a large blast of industrial explosives, the quarry produced 8,700 tons of limestone during the month of January, 1951. The blast, made on January 18, is typical of the general procedure of such operations. With C. O. Mayer, a sales-service representative of Hercules Powder Company, observing procedures, the blast was loaded with 6,000 pounds of Hercomite* bag powder, in 12½-lb. bags, and 50 lbs. of Hercomite in 2 by 8-in. cartridges. The area of the blast in the solid involved 5,000 cu. yds. of limestone; the firing of the explosives charges produced 14,000 tons of broken rock.

Using a Bucyrus-Erie 22-T well-drill, nine holes 6 in. in diameter, spaced on 20-ft. centers, were drilled vertically into the limestone. The depth of the holes averaged 45 ft., each hole extending approximately 5 ft. below the quarry floor. The burden of limestone in front of the drill holes at the top of the working face ranged from 6 to 9 ft., and from 16 to 30 ft. at the quarry floor level. The holes were sprung with 40 lbs. of Gelamite* dynamite. The main charges of Hercomite varied from 500 to 650 lbs. per hole, each charge covered with 20 to 22 ft. of stemming. Screenings from the crushing plant waste pile were used as stemming material. The explosives charges were primed with Primacord and electric blasting caps, and the blast was fired with a conventional 50-cap (push-down type) blasting machine.

*Reg. U. S. Pat. Off.

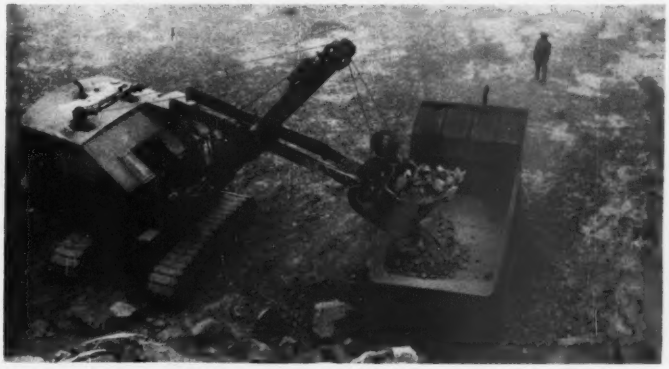
AFTER A BLAST: A blast of 6,000 pounds of Hercomite bag powder in the Slate Range quarry on January 18 produced this sloping mound of broken limestone. The yield from the blast was 2.8 tons of rock broken for each pound of explosives used.

Blasting Results

The explosives loading ratio for this primary blast was 1.20 lbs. of explosives for each cu. yd. of rock in the solid. The yield from the blast was 2.8 tons of rock broken per 1 lb. of explosives. Although the fragmentation was satisfactory, the results indicated that spacing the drill holes on 16-ft. centers in the future will produce more uniform initial breakage.

Considerable blockholing is necessary. For this work, JA 35 Ingersoll-Rand Jackhamers, equipped with 1⅛-in.-gauge hypotungsten carbide bits, are used for drilling holes in the bigger boulders for secondary blasting with small charges of dynamite.

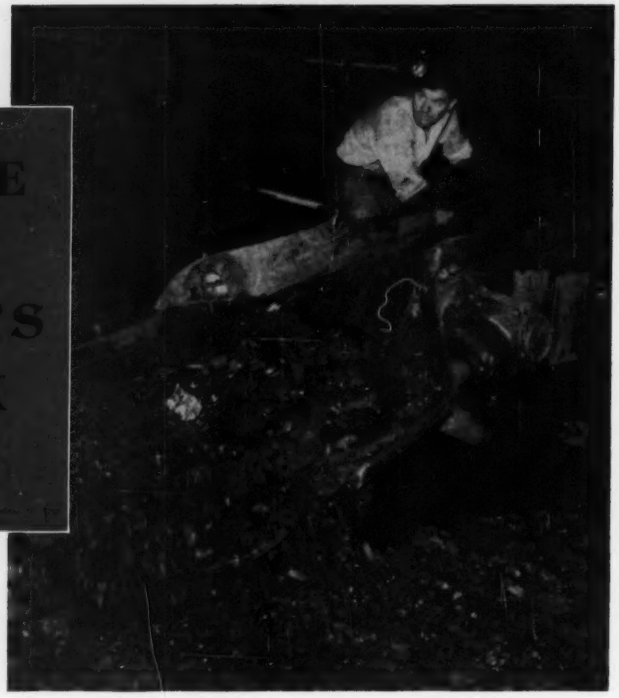
(Continued on page 152)



RECOVERING BROKEN STONE: After blasting, the bank of broken limestone in the quarry is recovered by the employment of a 1-cu. yd. Model 342 Marion power shovel that loads into a 10-ton Euclid rear-dump truck for transportation to the crushing plant.

THE CRUSHING PLANT: At the crushing plant, the limestone is dumped into a 28 by 36-in. Traylor jaw crusher from where it is moved onto a Simons vibrator screen with 2-in. mesh. Limestone smaller than 2-in. is discarded as waste.

DUQUESNE LIGHT COMPANY'S WARWICK MINES



LOADING THE COAL: One of the crew operating a Joy 14 BU caterpillar-mounted loading machine recovers and loads out the coal after a blast in No. 1 mine.

A summary of modern mining activities that yield an average production of 5,000 tons of coal each day

J. P. HASTINGS*

DUQUESNE LIGHT COMPANY, an electric utility company in western Pennsylvania, supplies a large percentage of the power and illumination requirements in the Greater Pittsburgh District. The district includes the city of Pittsburgh and adjoining communities, plus the extremely active industrial area of the Ohio River Valley. The company has kept pace with the demands of the public through the years by formulating and carrying through carefully designed programs of plant expansion and the construction of new facilities.

Two of the units, the Brunots Island and the James H. Reed power stations, are located on the Ohio River, near Pittsburgh. Most of the coal requirements for these stations are supplied from the company's Warwick mines located at Greensboro, Pennsylvania, on the Monongahela River. Deliveries from the mines to the power stations are made by river barges.

*Hercules Powder Company, Pittsburgh, Pennsylvania.

In 1931, the Philadelphia Company, parent of Duquesne Light Company, leased several coal mines in southern Greene County, in the Sewickley and Pittsburgh seams. Additional acreage in the county was acquired in 1938 from Fredericktown Coal and Coke Company, and other coal lands were added as opportunities arose. After the acquisition of the Warwick properties, the company decided to consolidate its holdings, to operate the mines in the Sewickley seam, and to close the mines in the Pittsburgh seam for a ten-year period.

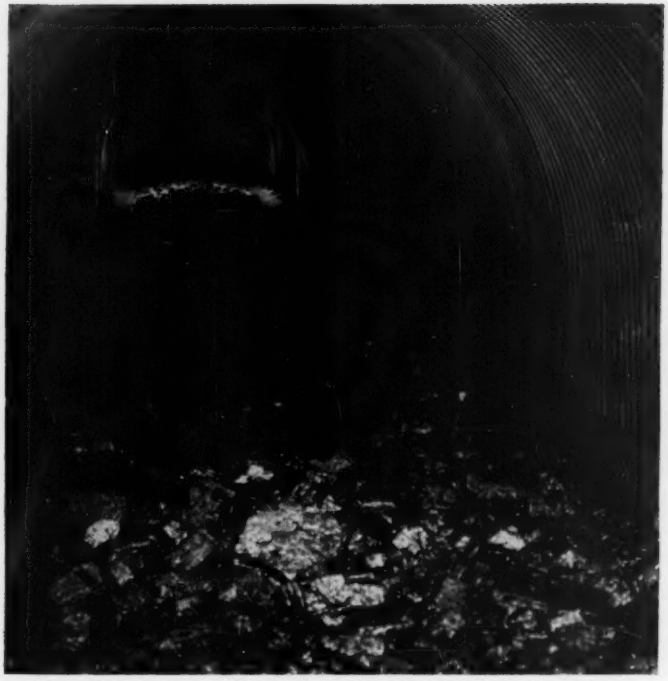
Coal Production Modernized

In 1940, when Government authorities announced the start of an accelerated program for national defense, the management of Duquesne Light Company realized that production from the Reed and Brunots Island stations would have to be stepped up. This would call for an increase in the requirements of coal for fuel at these two stations. Accordingly, they replaced the old hand-loading mining facilities with new, modern methods and equipment at an improved centralized location.

The new developments provided for large-scale mining in both the Sewickley and the Pittsburgh seams and for greatly improved coal preparation. Today, these improved mining and plant operations produce an average of 5,000 tons of coal a day, with a working force of 650 men.

Both the Sewickley and the Pittsburgh seams of coal are in the Monongahela formation, with the Sewickley bed approximately 90 ft. above the Pittsburgh bed.

The overburden above the Sewickley seam is from 150 to 200 ft. The coal bed averages 4½ ft. Impurities in the seam vary from a ½-in. parting of shale in the middle to several partings in the top and bottom. Approxi-



TO THE PLANT: Coal from both mines is merged on the outside, rotary dumped by a two-car unit, and transported to the preparation plant on a 48-in. conveyor belt.

READY TO BLAST: Three drill holes in a face in No. 1 mine have been loaded with permissible explosives, primed with electric blasting caps, and are ready to be fired individually.

mately 12 ft. of the roof is a hard, black laminated sandy slate with an overlying stratum of gray sandstone. The floor, for the most part, is a hard sandy shale of a "rolly" nature.

In the Pittsburgh seam, the coal bed averages 7 ft. This is overlaid with 6-in. to 24-in. layers of draw slate, interbedded with coal of about the same thickness, to a height of about 10 ft. above the top of the coal. Immediately above these formations is the main roof, composed of shaly sandstone. This sandstone extends upward into a limestone bed that varies from 15 to 30 ft. The principal coal seam is multibedded, with partings of the familiar "bearing in bands" at about 48 in. from the bottom. The floor of the seam is a hard clay that softens readily after exposure to air and water. The floor is uneven with frequent "rolls." Because of this condition, undercutting the seam is very difficult, if not impractical.

Underground Mining Operations

The block system is used at No. 1 mine Sewickley. Roof protection is provided by the conventional type of timbering. In some instances, this is supplemented with roof bolting. At present the mine is working on a three-shift-a-day basis, with seven mechanical units in operation. The equipment includes Universal-type track-mounted cutting machines, Jeffrey A 7 Permissible coal drills, Joy 14 BU caterpillar-mounted loading machines, and 8-ton cable-reel locomotives. Some units load directly into 4-ton-capacity steel mine cars; in other instances, the machine loads into a shuttle car that transports the coal to a belt conveyor. The conveyor moves it along to a panel entry where it is loaded into mine cars for transportation to the two-car rotary dump outside.

All places are bottom cut and sheared to a depth of 9 ft. Generally, the shear is placed about one-third the width of the place from the right rib, and the cut is blasted with three holes. These holes slant upward and are placed approximately 15 in. below the draw slate. They are drilled 8½ ft. deep, utilizing 1¾-in. augers and 2-in. tungsten carbide bits.

Blasting

Permissible explosives in 1¼ by 8-in. cartridges are used. Each charge of explosives is primed with a Hercules* Electric Blasting Cap, and the loaded bore holes are stemmed with tamping bags filled with clay. The charge in each hole is fired separately with a permissible-type battery. The yield from a blast averages 5.85 tons of coal per pound of powder used.

In No. 2 mine Pittsburgh, the block system is also used, but with some variations from that used in No. 1 mine Sewickley. Five mechanical units on a three-shift basis operate with equipment similar to that used at No. 1 mine. However, the loading machine

*Reg. U. S. Pat. Off.

loads the blasted coal directly into 5-ton-capacity steel mine cars. Movement of the loaded cars is provided by an 8-ton cable-reel gathering motor.

All solid places about 12 ft. wide are top cut and sheared on each rib, and two holes are drilled in each cut. The holes are placed about 12 in. from the bottom and slanted downward to reach bottom at the back of the cut. Permissible explosives in 1¼ by 8-in. and 1⅝ by 8-in. cartridges are used to load the holes. Each charge is primed with a Hercules Electric Blasting Cap. An average of 5.24 tons of coal is produced per each one pound of powder loaded in a blast.

In pillar mining, where the cuts are open end and approximately 20 ft. wide, the top is cut and one shear is made. In such instances, three holes are drilled and blasted.

These methods of coal recovery were decided upon after considerable experimentation. They offer advantages in that both roof coal and rib coal are protected from possible shattering effects from the explosives used; the straight rib on each side of the place contributes to loading efficiency and affords solid rib support for timbers which are hitched in the rib; and only small amounts of coal have to be shoveled by hand.

Roof Supports

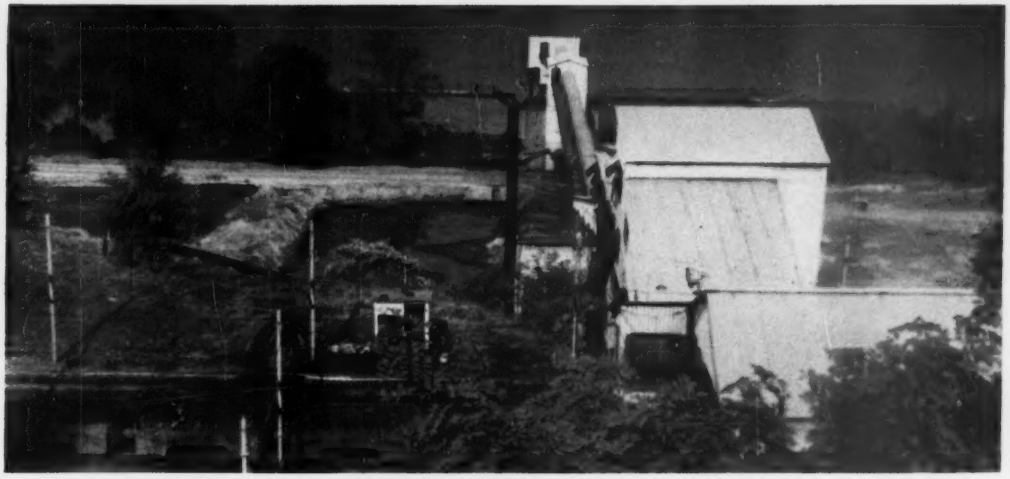
Timbering is kept sufficiently close to the face to provide maximum protection for the machine operators. After cutting a place, the machine is utilized to cut two hitches in each rib at roof level. The first hitch is cut 2 ft. and the second 6 ft. from the face, each about 18 in. deep. Before a blast is fired in the place, two 6 by 8-in. timbers 14 ft. long are slipped into the hitches and wedged into place. Besides providing protection, they eliminate timber legs which retard loading or which might create a hazard by being knocked out of place during loading operations.

In other working places, roof bolting is being employed with good results. For this work, a Joy WK 30 Permissible self-propelled track-mounted compressor is used in No. 1 mine, where the roof is hard. Baker Fletcher self-propelled hydraulic drills

BLASTING RESULTS: This pile of broken coal is representative of the consistently satisfactory results obtained from the blasts.

LOADING MINE CARS: The coal in No. 2 mine is dumped from a shuttle car into mine cars for delivery outside to the plant.

TIMBERS IN PLACE: To provide maximum protection for machine operators in No. 2 mine working places, timbers are installed close to the face.



AT THE PLANT: In the foreground, mine cars loaded with coal from both mines are being moved up to be rotary dumped by a two-car 900-ton-an-hour-capacity unit onto a 48-in. belt conveyor for delivery to the preparation plant and tipple in the background.

LEFT TO RIGHT: Eugene Downer, mine No. 2 foreman; John Stephenson, superintendent; Mike Rafter, mine No. 1 foreman; Albert Hood, assistant superintendent; Isaac Rumble, safety engineer.

RIVER BARGES: After processing in the plant, the coal is loaded into river barges for transportation to the power stations on the Ohio River.

are used in No. 2 mine, where the roof is easier to drill.

In both No. 1 mine Sewickley and No. 2 mine Pittsburgh, careful consideration and attention are given to proper ventilation and drainage.

Coal Preparation

In hauling the coal to the outside, the production from both mines is merged, rotary dumped by a two-car 900-ton-per-hour-capacity unit, and conveyed by a 48-in. belt to the preparation plant. At the plant, all plus 5-in. coal is hand picked and crushed, the 5-in. to ½-in. sizes washed and prepared, and recombined with the minus ½-in. which is not washed. The coal is then conveyed to the tipple for screening and loading into river barges for transportation to its power plant destination on the Ohio River.

Officials of Duquesne Light Company, Coal Division, include W. G. Jens, vice president of operations; J. E. Elkin, general superintendent; and J. A. Younkins, assistant general superintendent. The operations at the company's Warwick mines are under the direction of John Stephenson, superintendent; Albert Hood, assistant superintendent; M. B. Rafter and E. D. Downer, mine foremen.

The author is grateful to Duquesne's management personnel for cooperation in the preparation of this article.

WET GOING: Frank Sigley, conservation aide for Tygarts Valley Soil Conservation District, at left, about to load a dynamite cartridge in one of the holes 12 in. under water in No. 2 lateral ditch.

DITCH BLASTING RECLAIMS SWAMP AREA

Wet, mucky bottom land made useful by blasting with dynamite, with a minimum expenditure of time and money

E. A. PAIS*

THE property of the Adaland Country Club located about 4 miles northwest of the town of Philippi, in Barbour County, West Virginia, included 30 acres of very wet, mucky bottom land. A large part of this acreage was covered with standing water. Mechanical equipment could not be used to drain and reclaim the land because of the saturated heavy soil. Hand labor was impractical because of the time and money necessary to do the job properly. As a result, the land had been useless for general farming purposes for approximately 25 years.

About two years ago, the country club management appointed a committee of its members to make plans for revamping and enlarging the golf course. The 30 acres of swampland were needed to complete the new layout, and investigations were conducted to determine the cost and the time required to drain and reclaim the area. Matthew Harrison, supervisor of the Tygarts Valley Soil Conservation District, U. S. Department of Agriculture, was consulted and, after exploring the swamp, it was decided to blast three ditches with dynamite through the wet, mucky soil—one main ditch and two lateral ditches. The main ditch was to be 2,300 ft. long, 5 ft. deep, with a bottom width of 4 ft. and a top width of 12 ft. No. 1 lateral was to extend 400 ft. in length, 3 ft. in depth, with a bottom width of 3 ft., and a top width of 7 ft. No. 2 lateral was to be 1,400 ft. long, 4 ft. deep, 3 ft. wide at the bottom, and 8 ft. wide at the top.

Swamp Area Surveyed

The swamp area was surveyed by the Tygarts Valley Soil Conservation District staff, under the supervision of Mr. Harrison and his associates, Jack L. Barrick and Frank Sigley, to determine the location of the center lines of the three ditches. After this was done and stakes were placed, holes were put down along the center lines by means of hand punches made from 5½-ft. lengths of pipe, 1¼ in. in diameter, with steel points welded on one end. Along the center line of the main ditch, the holes were punched 24 in. deep; in the lateral ditches, they were 15 in. deep. All of the holes were spaced on 14-in. centers. Since the grade for the three ditches was relatively the same, the punch bars and the wooden tamping rods were marked to insure uniformity in the depth of the holes and the seating

(Continued on page 155)

*Hercules Powder Company, Pittsburgh, Pennsylvania.

MAIN DITCH: This ditch 2,300 ft. long and 5 ft. deep, blasted with Hercules Ditching Dynamite in May, 1949, provides excellent drainage for the adjoining swamp and a satisfactory flow of water through it.

LEFT: The holes along the center line of No. 1 lateral ditch have been loaded with dynamite and the blast is ready to be fired.

RIGHT: Soon after the blast, water began to run through the ditch. Spectators were agreeably surprised at the absence of spoil banks.

CONTROLLED BLASTING: This view of the blast in No. 2 lateral ditch emphasizes the uniformity in the height of the muck and water as they shoot skyward, indicating careful planning and loading operations.

REPUBLIC'S TOBIN MINE WINS TOP SAFETY HONORS

"PROUDLY WE HAIL": As the Sentinels of Safety flag was attached to the pole under Old Glory, everyone joined in the singing of our national anthem.

Officials of Republic Steel Corporation pay tribute to their iron-ore miners at Crystal Falls, Michigan, for a perfect safety record

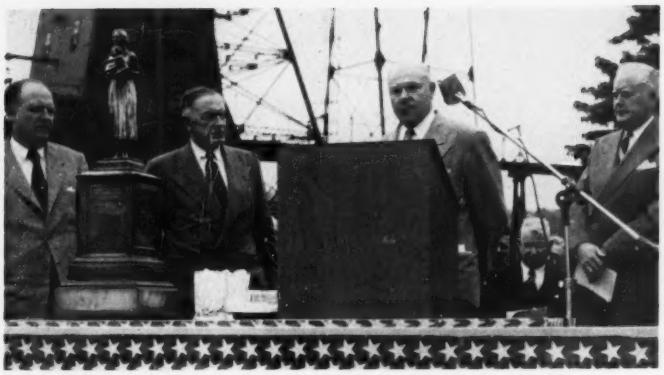
EMPLOYES of the Tobin iron-ore mine of Republic Steel Corporation, in Crystal Falls, Iron County, Michigan, worked 321,683 man-hours underground in 1950, without a lost-time injury. That perfect record in accident prevention was the best among the 50 metal underground mines enrolled in the National Safety Competition of 1950. The victory was a particularly happy one, as it marked the first time a mining property of Republic Steel ever won top honors in this annual nationwide safety contest during 14 years of enrollment.

In recognition of this splendid accomplishment, officials of the corporation met with the Tobin miners at the Crystal Falls property on Thursday, August 30, 1951, to participate in ceremonies honoring the local employes. Approximately 200 miners and guests were present.

Impressive Ceremonies

The ceremonies began with a brief talk by F. H. Cash, district manager of Republic's northern ore mines. He told the miners that everyone associated with the corporation got a big lift when the announcement was received that the men at Tobin mine were the winners in the metal mines group in the National Safety Competition. "We join with you," he said, "in being proud and happy about your record of having worked 321,683 man-hours underground through the 12 months of last year, without a lost-time accident. And I know that I speak for all of us when I say that we welcome with open arms the award of the Sentinels of Safety trophy which is being made to you today."

Mr. Cash introduced D. B. Gillies, mine consultant with the corporation and a long-time friend of the Tobin miners, as the master of ceremonies. Mr. Gillies spoke of the pleasure he experienced when asked to participate in the day's events. "My first visit to this mine was in 1900. Five years later, I came back here to work and I've been connected with the doings of this



LEFT TO RIGHT: E. H. Anderson, Tobin mine's superintendent; F. H. Cash, district manager of northern ore mines for Republic Steel Corporation; E. B. Winning, Republic's assistant vice president of operations; J. I. Horty, The Explosives Engineer's managing editor.

mine ever since, directly or indirectly. I recognize some of the men in your group today as my co-workers when I was here. It's like coming home. And, as Mr. Cash has said, all of us with Republic are mighty proud of the safety record you made last year. Now that you've come out on top in safety among the metal miners we hope you will repeat your victory again and again."

Sentinels of Safety Trophy

Mr. Gillies then introduced J. I. Horty, managing editor of THE EXPLOSIVES ENGINEER to make the award of the Sentinels of Safety trophy and flag. After extending his congratulations and those of his associates, Mr. Horty said that "the Bureau of Mines men in Washington tell me that Tobin mine has been competing in the National Safety Competition for 14 years, and that you received Certificates of Achievement in Safety for records close to the winners in the 1939, 1940, 1945, and 1947 competitions. And, last year your efforts were rewarded with your first winning of the first prize, the bronze Sentinels of Safety. That's what I call perseverance with a capital P. Each of you Tobin miners has earned all the good things that are being said about you."

W. M. KELLEY: In his remarks, Republic's vice president of operations extended sincere congratulations to each miner from everyone in the corporation from top to bottom.

At the conclusion of his remarks, Mr. Horty presented the trophy to E. B. Winning, assistant vice president of the corporation. In accepting the award, Mr. Winning expressed his appreciation for the efforts of the U. S. Bureau of Mines in conducting the National Safety Competition, and to the management of THE EXPLOSIVES ENGINEER in providing the Sentinels of Safety trophies for the winners. "We folks in the mining business are grateful for your help," he said. "The annual contests have stimulated greater interest in safety on the job among our men who do the work in the mines, and among our supervisory and management personnel. The records show that the accident-severity and frequency rates have been lowered very decidedly through the years since this nationwide safety competition was started in 1925."

In closing, Mr. Winning congratulated the Tobin mine employes, after which he presented the trophy to Mr. Cash. The district manager, in turn, presented it to E. H. Anderson, superintendent of the local operation.

Mr. Horty awarded the green-and-white Sentinels of Safety flag to the miners through their committee of acceptance: Emil Johnson, mine captain; G. Floodstrand, underground foreman; J. R. Tregear, safety inspector; M. Jacka, mechanical foreman; and Herman Berg, surface foreman.

Individual Awards

S. H. Ash, in charge of the safety and health division of the Bureau of Mines, called to the stand John Sabol, the oldest employe in years of service, having worked at Tobin mine 47 years. After commenting on his long record of faithful work performance, Mr. Ash presented Mr. Sabol with a pin from Republic Steel Corporation and an individual Certificate of Achievement in Safety from the Bureau of Mines. This was followed by the awards of similar pins and certificates to each employe in the Tobin mine group.

The formal program closed with an impressive address by W. M. Kelley, vice president in charge of Republic's operations. In his talk, Mr. Kelley said, "The men who are with us today from Washington, and from Delaware, Ohio, and Minnesota didn't come here to attend something ordinary. They came because they wanted to be present and to give their support to the safety program that all of us are trying to make a part of each working day."

JOHN SABOL: Mr. Sabol, right, Tobin's oldest employe in years of service, receives a pin and a certificate from S. H. Ash, the U. S. Bureau of Mines representative.

EACH MINER REWARDED: A company pin and an engraved certificate from the Bureau of Mines were awarded to each miner for his contribution to the 1950 no-accident record.

You can't do anything about accidents that have happened, except to talk about them. But, you can do something about preventing another accident from happening, and that is the primary objective of the National Safety Competition.

"Look at the Trophy"

In his concluding remarks, the speaker said, "I never realized just what the Sentinels of Safety trophy should mean to all of us until I heard it explained today. The sculptor has fashioned a bronze statue that represents a mother holding her baby in her arms, with the baby reaching out to welcome the father on his safe return from his work. Think of the picture that brings to mind—the mother and the child standing in the doorway of their home to greet the father as he comes home safe and sound from his work. That's what all of us are working for—to provide the means for ourselves and our families to live together safely and happily.

"Earlier in the program today we were asked to take a long look at this trophy. I did and I got the message it was intended to give. I hope all of you will take a look too. It will help to strengthen your determination to keep up the magnificent job you did last year, the making of a perfect record of no lost-time accidents on the job."

Following Mr. Kelley's talk, the acceptance committee, under the supervision of Tobin mine's captain Emil Johnson, raised the Sentinels of Safety flag to the top of the flagpole under Old Glory. As the flags unfurled and waved aloft in the breeze, everyone joined in the singing of our national anthem.

WELL-DRILL BLASTING IN BLOCKY CALIFORNIA LIMESTONE

(Continued from page 143)

Superintendent Ousley is an enthusiastic booster of Hercules explosives and service. "We use Hercules products exclusively here," he said, "because they do the job we want done, effectively and economically."

Chuck Ousley, a superintendent at quarry operations since 1931, is particularly proud of his perfect safety record. He handled explosives at other California and Nevada operations for ten years prior to moving to Westend. His record of no-lost-time accidents on the job extends over that period of previous operations also.

"I never forget it's dynamite I'm handling," Ousley said seriously, "and I handle and use it accordingly."

Recovering Broken Limestone

After blasting, the recovery of broken limestone in the quarry is accomplished by the operation of a 1-cu. yd. Model 342 Marion shovel that loads into a 10-ton Euclid rear-dump truck. At the crushing plant the rock is dumped into a 28 by 36-in. Traylor jaw crusher with 6-in. openings, after which it is moved onto a Simons vibrator screen with 2-in. mesh. Limestone smaller than 2-in. is discarded as waste, because such small sizes become highly compacted in the kilns and reduce the draft. After passing over the vibrating screen, the sized limestone is hauled 18 miles to the chemical company's plant in three GMC 18-ton trailers and semi-trailers.

The overall operations in the quarry and crushing plant are under the direction of H. D. Hellmers, the company's general works manager, and Lynn Blackmunn, technical director. As indicated, Charles E. Ousley is quarry superintendent. John Aitchinson is production manager at the plant.

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ELECTRIC BLASTING CIRCUITS

(Continued from page 137)

If mobile transmitting stations up to 30 watts in automobiles are kept 50 ft. away from blasting operations, there is probably little hazard. Doubling the distance would be highly desirable. For closer distances the transmitter should be kept strictly turned off and preferably locked. If electric blasting caps are to be carried in a truck or automobile equipped with a two-way radio, they should be stored in a metal box, preferably grounded. In any handling of electric blasting caps closer to the radio than 100 ft., the transmitter should be off.

In connection with radios on boats, vertical antennas should be used and, because of the close quarters, the transmitters should be turned off when caps are being handled. Electric blasting caps on boats should be stored in grounded metal magazines.

CONCLUSION

It is true that electric blasting caps can be detonated by radio. However, it is our opinion that by observing reasonable precautions, such as minimum distances in proximity to radio transmitters, or turning the transmitters off, operations can be conducted with relative safety.

The facts stated and the information included herein are based on our own research and research of others and are believed to be accurate; however, Hercules Powder Company does not make any guarantee concerning the accuracy thereof.

TABLE III

RADIO TRANSMITTING STATIONS
PARTIAL LIST

Type	Frequency	Wave Length* =983 ÷ Frequency (Megacycles)	Power
	Commercial Broadcast		
AM	540 - 1,600 kilocycles (0.54 - 1.6 megacycles)	1820 - 615 ft.	Up to 50,000 watts
FM	88 - 108 megacycles	11.2 - 9.1 ft.	Up to 550,000 watts
TV	50 - 88 megacycles	19.7 - 11.2 ft.	Up to 50,000 watts
	174 - 216 megacycles	5.6 - 4.5 ft.	Up to 50,000 watts
	Amateur		
	1.8 - 2.0 megacycles	545 -490 ft.	
	3.5 - 4.0 megacycles	280 -246 ft.	Up
	7.0 - 7.3 megacycles	140 -135 ft.	
	14.0 - 14.4 megacycles	70.0 - 68.2 ft.	to
	26.96 - 27.23 megacycles	36.6 - 36.0 ft.	
	28.0 - 29.7 megacycles	35.1 - 33.0 ft.	1,000
	50.0 - 54.0 megacycles	19.7 - 18.2 ft.	
	144 -148 megacycles	6.8 - 6.65 ft.	watts
	220 -225 megacycles	4.46- 4.36 ft.	
	(and others scattered in the range 1,215-30,000 megacycles)		
	Two-Way Communication Systems		
	Low-Frequency Range		
	25 - 50 megacycles	36 - 18 ft.	
	Central Station		Up to 5,000 watts
	Mobile Unit		1-60 watts
	High-Frequency Range		
	148 - 174 megacycles	6.3 - 5.3 ft.	
	Central Station		Up to 5,000 watts
	Mobile Unit		1-50 watts
	Radar		
	(Representative Types Used in Connection with Ship Navigation and Aviation)		
Loran	1.8- 2.0 megacycles	545 -490 ft.	
Gee	20 - 85 megacycles	49.1 - 11.6 ft.	
Shoran	210 -320 megacycles	4.7 - 3.1 ft.	
Microwave	3,000 megacycles	10 cm.	
Microwave	10,000 megacycles	3 cm.	

*Individual cap wire lengths equal to one-quarter wave length introduce the greatest hazard. Because of end effects the quarter wave length should be multiplied by 0.95 to get the most efficient antenna.

Note: The above table is not complete and will likely change from time to time.

NEWS NOTES

NOVEL TECHNIQUE LOCATES UNDERWATER BEDROCK STRUCTURE

A newly designed electronic depth-finder, used normally on naval vessels to measure the ocean's depth, has been successfully used to locate the level of bedrock under deep silt deposits in Chicago harbor. Time and money saved by this method over the usual technique of tedious test boring would indicate an important milestone in geological survey work under water.

More information about this new equipment may be obtained by communicating with Edo Corporation, College Point, Long Island, New York.

DIAMOND CORE DRILLS

Bulletin No. 71, available from E. J. Longyear Company, Minneapolis, Minnesota, gives up-to-date specifications and operating data on Wolverine drills. The electric models are equipped with a clutch located between the motor and the three-speed transmission, permitting instant stopping of the drill without shutting down the motor, according to the company. All models have a transmission which allows a selection of three drilling and three hoisting speeds.

McCARTHY DRILLS

The Salem Tool Company, 775 South Ellsworth Avenue, Salem, Ohio, is prepared to supply full descriptive literature on its line of McCarthy drills—the self-propelled horizontal drill for blasthole drilling and the vertical drill for any job where ordinary rock formations are to be blasted. All McCarthy units can be operated with gasoline, Diesel, or electric power units.

PIPE JOINTS

The GACO Rubber-Lined Pipe Joint System is described in a manual recently

issued by the Gates Engineering Company, Box 1711, Wilmington, Delaware. The manual includes lists of fittings, as well as a corrosion list to which GACO gaskets and linings are resistant. It may be obtained from the Gates Engineering Company.

MINING MOTORS

General Electric Company, Schenectady, New York, has announced a new line of mining motors, said to be explosionproof. They are available in ratings from ½ through 60 hp. at 230, 250, 500, and 550 volts, with stabilized shunt, compound, or series windings. Standard motors are foot-mounted, but modifications can be supplied without feet for strap-mounting, or with a face or flange end shield.

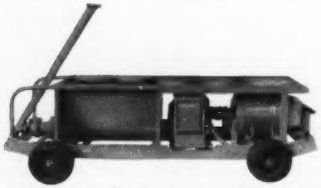
Detailed data on these motors may be had by writing to General Electric's Small and Medium Motor Division.

EXCAVATORS

A new 32-page bulletin on Marion all-purpose excavators has been announced by Marion Power Shovel Company, 617 West Center Street, Marion, Ohio. The booklet lists condensed specifications and types of service to which the machines can be converted for use.

ROCK DUSTER

The "Little Chief" rock dusting machine has been improved, according to a recent



announcement by the American Mine Door Co., Canton, Ohio.

The winch model is especially suited to low seams as it has incorporated into its design a winch capable of pulling the duster on, off, or over belts or pan lines, bringing up supplies and other pulling jobs.

The American Mine Door Co. will furnish detailed information on the "Little Chief."

ELECTRIC PALLET TRUCK

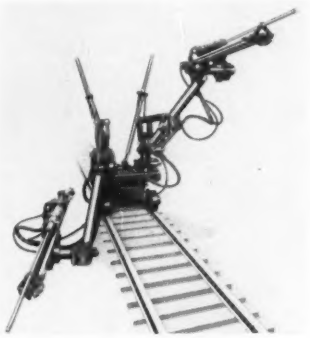
Designed to speed up handling by enabling the operator to ride while picking up and delivering loads, the Spacemaker Low-Lift, manufactured by Lyon-Raymond Corporation, travels up to 4 mph. carrying as much as 4000 lbs. and at 5 mph. when empty, according to the manufacturer. It is available with carrier frame 30 to 60 in. long, and 24, 27, or 30 in. wide. A detailed description may be had by addressing Lyon-Raymond Corporation, 145-83 Madison Street, Greene, New York.

MINE FANS

Joy Manufacturing Company, Pittsburgh, Pennsylvania, offers a new bulletin, No. J-609, illustrating its line of Series 1000 Axivane mine fans for intermediate-pressure installation. A dimension drawing and selection table included permit approximation of fan requirements. Write direct to Joy Manufacturing Company for additional details on these fans.

JUMBO DRILLING RIG

Ingersoll-Rand Co., Phillipsburg, New Jersey, is offering a boom jumbo drilling rig, designed for high-speed driving of drifts, cross-cuts, and tunnels. This standard machine is capable of working in an open-



ing with a maximum height of 10 ft. and a width of 12 ft., but the booms can also be purchased separately to mount for work in larger tunnels. Booms are of heavy seamless steel tubing with vertical supports.

ELECTRIC HOISTS

The American Chain & Cable Co., Inc., York, Pennsylvania, announces that its new electric hoists are made with a shorter, deeper drum and are lighter and better balanced. As the highest capacity offered is 1,000 lbs., the hoists use two parts of 3/16-in. Trulay cable, a smaller load hook, and a smaller trolley. The hoists have shaved gears, and the lower limit switch is standard equipment. Write to the Wright Hoist Division of the company for more data.

AMERICAN REVOLVER CRANES

A new catalog featuring American Revolver Cranes in industrial use has been released by American Hoist & Derrick Company of St. Paul, Minnesota. The catalog shows many specialized applications of this equipment, and should be of interest to persons concerned with large-scale material-handling problems. Copies of Catalog No. 400-R-3 are available by addressing the American Hoist & Derrick Co., 63 South Robert Street, St. Paul 1, Minnesota.

RIPPING, DOZING EQUIPMENT

The Hensley Equipment Company claims that brush and rock removal for construc-

tion and maintenance of roads is speeded by the use of its new ripper attachment. Twelve models of the Hensley Rippers are available to fit standard bulldozers and scrapers. The shanks of the rippers have the benefit of the full weight of the dozer blade. They are angled for automatic digging into rock, shale, or soil. The instrument will dig to a depth of 12 in. in one pass if there is not an excessive amount of rock in the surface. Two 6-in. passes provide adequate ripping action when a large amount of rock or shale is encountered.

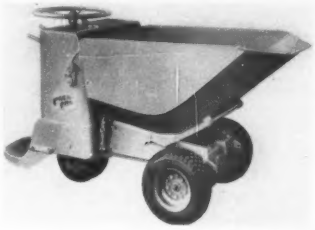
The address of the Hensley Equipment Company is 878 Joaquin Ave., San Leandro, California.

SIDE-DUMP TRAILER

Available in rated capacities of 14, 17, and 20 tons, newly improved Easton Model TP trailers are said to provide a 12% increase in water-level capacity with no change in overall dimensions over previous models. The doorless pan-type trailers may be dumped to either side and the body is reversible to prevent excessive wear on one side. Descriptive bulletins are available from the Easton Car & Construction Company, Easton, Pennsylvania.

POWER WHEELBARROW

Kwik-Mix Company, Port Washington, Wisconsin, is manufacturing a power wheelbarrow, the Moto-Bug, equipped with interchangeable front-end attachments including a power-driven fork lift attachment, a gravity dump hopper flatbed platform, scraper blade, and a manually operated fork



lift. The power-driven fork attachment has a 1,000-lb. lift capacity and raises the load to a maximum height of 30 in. A 4-hp. gasoline engine furnishes the power, and direct steering to dual rear wheels allows the machine to turn in its own length.

DITCH BLASTING

(Continued from page 148)

of the dynamite charges in the holes. This procedure, in turn, insured a uniform depth level for the three ditches, a desirable feature for both drainage and appearance purposes.

Loading the Dynamite

In the main ditch, each hole was loaded with two 1¼ by 8-in. cartridges of Hercules* Ditching Dynamite; in the lateral ditches, one cartridge was loaded into each hole. The blasts

*Reg. U. S. Pat. Off.

FOR
FASTER
Drilling
THE
McCARTHY
VERTICAL
DRILL

For record-breaking performance... for ease of operation, you can't top a McCarthy Vertical Drill. Recently, on one difficult job, workers using McCarthy equipment drilled an 8-inch hole 100 feet deep in only 40 minutes! The derrick is raised and lowered by hydraulic power . . . finger tip controlled . . . and a 60 H. P. gasoline motor is part of the standard equipment.

The McCarthy Vertical Drill, manufactured by The Salem Tool Co., is adaptable to high wall and key way drilling and diamond drill boring . . . drills 90% of all limestone and sand rock formations, and readily burrows through shale. Send today for complete information, and for a free copy of The Salem Tool Company booklet.

MINING EQUIPMENT SINCE 1901

SALEM

THE SALEM TOOL COMPANY

were fired by the propagated method. This was accomplished by inserting one electric blasting cap as the primer in one dynamite cartridge in the fifth hole from one end of each of the three lines of ditches. When the E. B. caps in each line were fired, the dynamite cartridges in all the holes in each line were detonated and fired, seemingly at the same time. The water in the ground acted as a conductor for carrying the wave of detonation from the first exploded cartridge to the dynamite loaded in adjoining holes, and so on down the line of loaded holes.

The leading wire between the electric blasting cap detonators and the 10-cap blasting machine was 250 to 300 ft. long. It was extended from the line of the ditches at an angle of about 50 to 60 degrees to permit the blaster to stand at a safe distance from possible flying soil and muck.

Ditching with Dynamite Provides Excellent Drainage

The main ditch referred to in this article was surveyed and blasted in May, 1949. An accompanying photograph shows the excellent condition of the ditch at the present time, and indicates the stream of water it normally carries. The depth of the ditch has proved to be adequate to carry off water resulting from heavy rains, thus preventing the flooding of the bottom meadow land on either side. The two lateral ditches were blasted on June 29, 1951. The results from the blasts were completely satisfactory and excellent drainage for the area has been provided.

Since the Tygarts Valley Soil Conservation District staff surveyed the ditches, supervised the punching of the holes, loaded the dynamite, and fired the blasts, the only expense to the land owner for the 4,100 ft. of ditches was the cost of the materials used, plus wages for about 30 man-hours of labor. It is obvious that these ditches could not have been realized as economically or as quickly by any other drainage method.

Hundreds of Acres Reclaimed

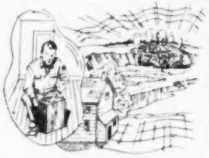
Throughout this vicinity, particularly in the area comprising the Tygarts Valley Soil Conservation District, hundreds of acres of bottom land have been drained and reclaimed at comparatively low cost to the land owners by ditching with dynamite. This method of providing ditches has proved to be satisfactory everywhere it has been used. It has become recognized and adopted by most of the land owners. This is particularly so with the farmers for whom most of the work of ditching with dynamite has been done.

Union Pacific Coal Company

(Continued from page 140)

Theodore Marvin, director of THE EXPLOSIVES ENGINEER, reminisced on the first days of the National Safety Competition, pointing out that the three-time victory of Reliance No. 7

VIBRATION TROUBLES?



EXPLOSIVES USERS—If you are experiencing or anticipate legal or public relations problems arising from blasting effects—

Send For Our **NEW BROCHURE** *Describing Our Services*

"VIBRATION PROBLEMS CONNECTED WITH BLASTING: THEIR SOLUTION AND CONTROL BY SCIENTIFIC METHODS"

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mine brilliantly reversed the philosophy of the conception of the trophy. The mother and child, he said awaiting the safe return of the father from his work was to be the shining goal—always sought for but probably never attained. "Now," he said, "it has been proved that bituminous-coal mining can be raised to a high level of safety, so high that it is the miner who hopes, on his return from his work, that his family has been maintained in an equal degree of safety during his absence underground." Mr. Marvin appealed to the Reliance miners to continue to hold fast: to their safety enthusiasm; to their great mining team companionship; to their confidence in their company's safety management; to their own spirit of independent thought and action in finding better and safer ways of doing the job; to their belief in the continuing support of God in a job well done. "Hold fast in these things," he said, "and they will continue to inspire men in other mines and quarries throughout the world to follow your splendid leadership."

Mr. Livingston expressed the sincere and heartfelt appreciation of the company for the fine work of the men at Reliance No. 7 and at the other Union Pacific coal properties, all of whom have done exceptionally splendid work in safety. He called on General Manager V. O. Murray to present the individual Certificates of Achievement in Safety to Lawrence Welsh, mine superintendent of the Reliance Mining District. Mr. Welsh enthusiastically commended the men for their team effort.

"We'll Keep Pitching"

Representing the men, Terry Martin, fire boss, Reliance No. 7 mine, accepted the trophy, the safety flag, and the certificates. "We'll do our best to maintain this high standard, for we realize the benefits we get from our efforts," he promised. "With the continued fine support of management and the cooperative spirit between us all, we'll keep pitching."

With the benediction by the Reverend Thomas E. Rodda, a great inspirational dedication to accident prevention came to a close.

Years of Service

"Clipper" Drills are built to outperform. That is why quarry operators prefer them.

* * *

Write for full information.

THE LOOMIS MACHINE COMPANY
TIFFIN, OHIO
Established 1842

Your drilling cost can be at a minimum only if the machine you use is the proper size for the formation being drilled. The size needed depends entirely on the formation to be drilled and the diameter of the drill hole.

Tools play an important part too. Just recently, we cut drilling costs for a large quarry with a 100-ft. working face by making drill bits designed especially for the formation they were drilling.

If your drilling costs are too high, or if you have a formation difficult to drill, we may be able to help you.

For full information write

THE SANDERSON-CYCLONE DRILL CO.
ORRVILLE · OHIO

PIT AND QUARRY MEN AGREE...

You can do the Job
BETTER, SAFER, FASTER
with
PRIMACORD®

PRIMACORD produces a powerful detonating wave which travels at approximately 4 miles per second throughout its length. It acts as the detonating agent for all holes in the shot.

The infinitesimal time lag between holes and rows of holes permits planned rotation firing, relieves burden. The powerful detonation of each portion of each charge produces more work from your explosives.

Primacord is insensitive to stray electrical currents —cannot be set off by friction, sparks or ordinary shock.

Add to this the ease of handling, simplicity of hook-up, and high tensile strength ... you'll see why it is the almost universal choice of pit and quarry men.

WIRE COUNTERED PRIMACORD. Armored with closely stranded brass wire, Wire Countered Primacord is the answer where deep, ragged holes and high abrasive conditions are encountered. The wire sheath increases tensile strength to 220 lbs. Weight per 1000-foot spool is 35 lbs.

PLASTIC REINFORCED PRIMACORD. Use it for extremely deep, wet holes, river crossings, or wherever water is a problem. It is also resistant to acids commonly encountered. Although Plastic Reinforced Primacord weighs only 22 lbs. per 1000-foot spool, its tensile strength is 250 lbs.

REINFORCED PRIMACORD. Depend on it for use in deep holes where extra tensile strength (160 lbs.) or resistance to abrasion are desirable. Tough, but resilient and easy to handle, it is gaining in popularity for general use. 1000-foot spool weighs 20 lbs.; tensile strength 160 lbs.

PLAIN PRIMACORD. For shallow holes, surface trunkline use and other applications where abrasive and other rugged conditions are not considerations. 1000-foot spool weighs 19 lbs., tensile strength 113 lbs. P-55

Users of Primacord agree that there is no substitute for its general excellence. Consult your explosives supplier for complete information, or write to us direct.

THE ENSIGN-BICKFORD COMPANY
Simsbury, Connecticut

PRIMACORD®-BICKFORD

DETONATING FUSE

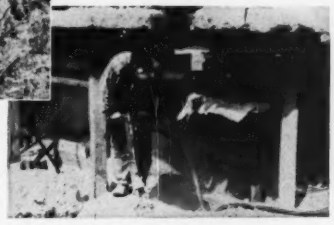
Also Ensign-Bickford Safety Fuse — Since 1836

Progress Reports Reveal Faster Progress

when *Gardner-Denver's* in your picture!

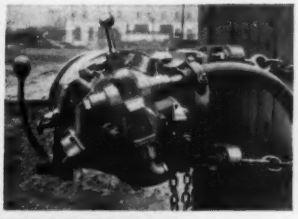
Air pressure's always up —when Gardner-Denver Portables feed your lines. Cylinders are water-cooled *all* the way down for all weather efficiency—compressors are two-stage for any altitude performance.

Holes are spotted quickly—drilled fast and clean with Gardner-Denver Wagon Drills.



Demolition proceeds at a steady pace—Gardner-Denver Breakers are easy on the operator—tough on concrete.

A clean hole drills faster — and Gardner-Denver Sinkers are noted for hole cleaning ability, powerful rotation.



For speedy pull and haul—powerful Gardner-Denver Air Hoists are easy to control.

Saves shop time for all pneumatic tools—L012 Automatic Oiler shuts off air when it runs out of oil.

Keeps water out of your way—Top-Suction VP4 Sump Pump won't burrow in the mud—keeps grit out of the pump shaft seal.

Write for further information.

Packs backfill swiftly and firmly—Gardner-Denver Tampers are easy to hold—seldom require maintenance—non-freezing.

Clay or hardpan doesn't waste time—when tackled with Gardner-Denver Clay Spaders and Trench Diggers.

SINCE 1859

GARDNER-DENVER

THE QUALITY LEADER IN PUMPS, COMPRESSORS AND ROCK DRILLS

Gardner-Denver Company, Quincy, Illinois

In Canada:

Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

Keep 'er rolling!

Clear the track — we're still running against time!

If we can keep the throttle of our Defense Special wide open, by 1953 the free nations of the world will have enough strength to make any possible aggressor think twice.

So beware phony "peace" signals, set by the lords of the Kremlin. They may be devised to slow down our defense effort—or shunt it onto a siding.

The only *real* guarantee of peace is strength—one word the Reds really understand.

Can we do the big job of arms production and keep right on supplying civilian goods too? Can we stave off needless shortages that take prices higher and lower the value of our dollar?

We *can*—if we improve our productivity. Americans have always excelled in turning out more and more for every hour we work. Now's the time to use every bit of skill and experience we've got to improve our machines and methods.

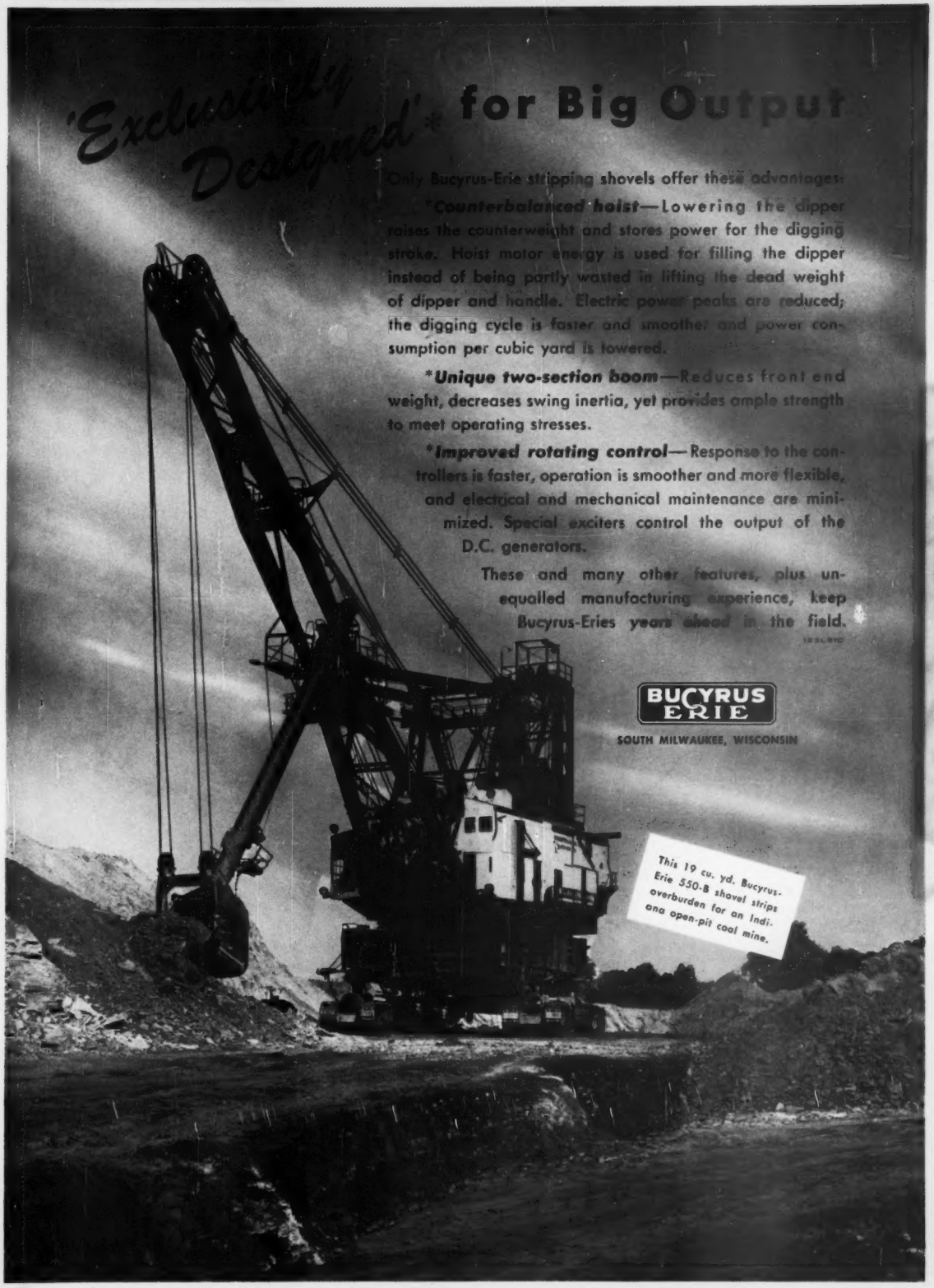
This drive for defense will continue to require sacrifices. But the reward is peace with freedom, and that is worth anything we have to give — or give up. No matter what your job is—try to do it better. Then you'll be doing your part to keep our Defense Special rolling!

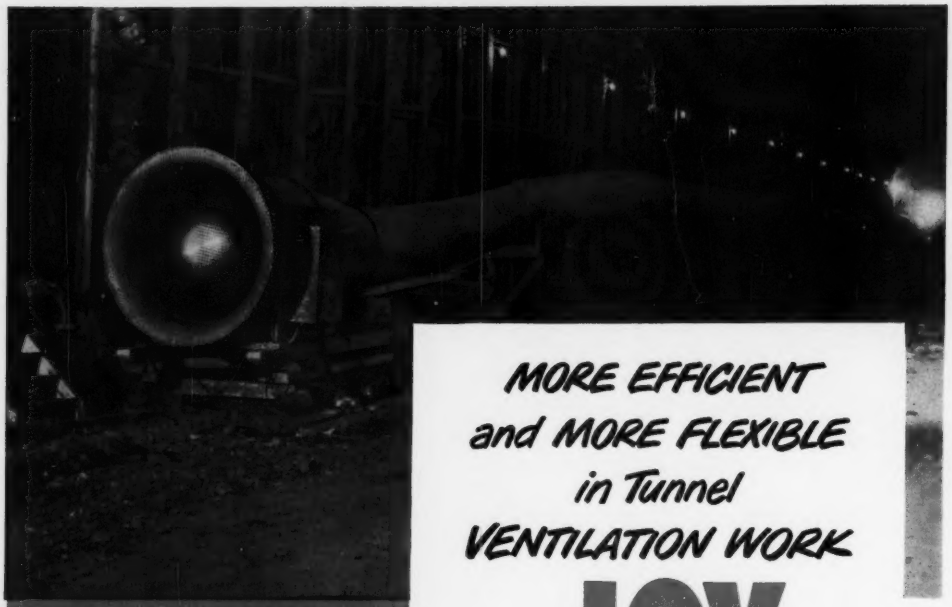
THE BETTER WE PRODUCE
THE STRONGER WE GROW

Compliment of

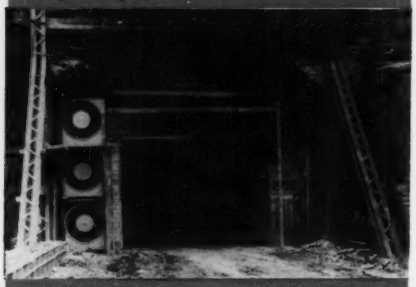
THE EXPLOSIVES ENGINEER

This advertisement was approved by representatives of management, labor and the public.


'Exclusively Designed'* for Big Output
Only Bucyrus-Erie stripping shovels offer these advantages:
*Counterbalanced hoist—Lowering the dipper raises the counterweight and stores power for the digging stroke. Hoist motor energy is used for filling the dipper instead of being partly wasted in lifting the dead weight of dipper and handle. Electric power peaks are reduced; the digging cycle is faster and smoother and power consumption per cubic yard is lowered.
*Unique two-section boom—Reduces front end weight, decreases swing inertia, yet provides ample strength to meet operating stresses.
*Improved rotating control—Response to the controllers is faster, operation is smoother and more flexible, and electrical and mechanical maintenance are minimized. Special exciters control the output of the D.C. generators.
These and many other features, plus unequalled manufacturing experience, keep Bucyrus-Eries years ahead in the field.
BUCYRUS ERIE
SOUTH MILWAUKEE, WISCONSIN
This 19 cu. yd. Bucyrus-Erie 550-B shovel strips overburden for an Indiana open-pit coal mine.



In this tunnel job, a JOY AXIVANE Fan blows air to the face through lengths of flexible Spiratube.



Typical exhaust set-up—three JOY AXIVANE Fans mounted in the entrance of one of twin bores.

MORE EFFICIENT and MORE FLEXIBLE in Tunnel VENTILATION WORK

JOY AXIVANE® FANS

with STANDARD ADJUSTABLE BLADES!

JOY AXIVANE Fans offer you the proved superior efficiency, low power consumption and quieter operation of vaneaxial design, *plus* the flexibility of easily adjustable blades to meet varying conditions—*plus* ready adaptability to installation in series for long-distance work. With JOY Fans, you can handle any tunnel job easiest and best, from start to break-through.

● Let us help *you* get greater ventilating efficiency.

Write for Bulletin, or *Consult a Joy Engineer*

W&D C 2814

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